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Claims

[c0001] 1. An actuating apparatus (1) for the impingement of at least two shift elements (42, 44) that are spaced apart from each other, each having at least a first engagement area (50, 52) for its actuation, comprising:
a drive shaft (10) arranged to be driven by a motor in both rotational directions;
the drive shaft (10) having a first thread profile (20);
a positioning device (28) screwed onto the first thread profile (20) of the drive shaft (10) via a second thread profile (22) that is complementary to the first thread profile (20); and,
a control element (30) that is connected to the positioning device (28) in a rotationally fixed manner which causes the positioning device (28) to be turned with the drive shaft (10) when the drive shaft (10) turns in a first rotational direction, at least one second engagement area (54) provided on the positioning device (28) being positioned on at least one first engagement area (50, 52) of at least one shift element (42, 44);
wherein the control element (30) controls an axial displacement of the positioning device (28) in relation to the drive shaft (10) when the drive shaft (10) turns in a sec-

ond rotational direction that is opposite the first rotational direction and with it an actuation of the at least one shift element (42, 44), on whose first engagement area (50, 52) the second engagement area (54) is positioned.

[c0002] 2. The actuating apparatus (1) as described in Claim 1, wherein the axial displacement between the positioning device (28) and the drive shaft (10) is limited so that, when the drive shaft (10) is turned in the first rotational direction, the positioning device (28) is entrained in the rotational direction after reaching the maximum displacement.

[c0003] 3. The actuating apparatus (1) as described in Claim 2, wherein the axial displacement of the positioning device (28) relative to the drive shaft (10) is limited by a stop (34).

[c0004] 4. The actuating apparatus (1) as described in Claim 2, wherein, when the drive shaft (10) turns in the first rotational direction, a braking device (174), whose braking force is greater than a frictional force occurring between drive shaft (10) and positioning device (28) during turning is operative on control element (30).

[c0005] 5. The actuating apparatus (1) as described in Claim 1,

wherein, when the drive shaft (10) turns in a second rotational direction, the control element (30) is inhibited from turning at a position set beforehand.

[c0006] 6. The actuating apparatus (1) as described in Claim 5, wherein the inhibition is caused by a torsional lock (102).

[c0007] 7. The actuating apparatus (1) as described in Claim 5, wherein an inhibition is provided for at least one position between a first and second engagement area.

[c0008] 8. The actuating apparatus (1) as described in Claim 1, wherein at least two shift elements (42, 44) are operated one after the other when there is a relative movement between drive shaft (10) and shifting device (28).

[c0009] 9. The actuating apparatus (1) as described in Claim 1, wherein at least one shift element (42, 44) effects an engagement of a gear of an automated transmission.

[c0010] 10. The actuating apparatus (1) as described in Claim 1, wherein at least one shift element (42, 44) operates a friction clutch in the drive train of a motor vehicle.

[c0011] 11. An actuating apparatus having a rotatably mounted drive shaft (10), said drive shaft (10) being movable about its longitudinal axis (26) in both rotational directions, namely in a first rotational direction (14) and a second

rotational direction (16) opposite the first, and having a nut/threaded spindle assembly (18) that has a threaded spindle (20) and a nut (22) whose thread (120) engages the thread (40) of the threaded spindle (20), it being possible for the part of this nut/threaded spindle assembly (18), that faces or is closer to the drive shaft (10) in the power flow, that is, the threaded spindle (20) or the nut (22), to be rotationally driven by the drive shaft (10), and the other part of the nut/spindle assembly (18), that is, the nut (22) or the threaded spindle (20), being coupled to a positioning device (28), especially fixedly coupled, so that the axial position of the positioning device (28) that is designed in particular in the direction of the longitudinal axis (26) of the nut (22) or the threaded spindle (20) may be changed, a stop (34) being provided that limits the axial mobility of the positioning device (28) in the one orientation of the axial direction and it being possible to run up against stop (34) via turning of the drive shaft (10) in a first rotational direction (14), and this stop (34) causing the positioning device (28) to be moved in an essentially purely rotary or swiveling manner after the stop (34) is reached and the drive shaft (10) continues its rotary movement in the first rotational direction (14), and the positioning device (28) being designed in a rotationally asymmetric manner with respect to the rotary axis or swivel axis (26) that is assigned to this movement and/or

has a positioning element (36) disposed in a rotationally asymmetric manner with respect to this rotary or swivel axis (26), the position of this positioning element (36) in the rotational direction being changed during its purely rotational or purely swiveling movement and at least one torsional lock that acts in particular in one direction or at least one one-way clutch (102) acting in particular in one direction being provided that can hold it in at least two rotary or swivel positions of the positioning device (28) in such a manner that in each of these holding positions, especially acting in one direction, a rotation or swiveling of the positioning device (28) about the rotary or swivel axis (26) is prevented if the drive shaft (10) is driven in the second rotational direction (16) so that the positioning device (28) in each case is then moved in an axial or translatory manner, especially when the rotary position remains the same, if the drive shaft (10) is driven in the second rotational direction (16) or is driven further.

[c0012] 12. The actuating apparatus as described in Claim 11, having a drive device (12) and having a positioning device (28) disposed so as to be movable in relation to this drive device (12) and moveable by the drive device (12), the position of the positioning device (28) being changeable in the rotational or swiveling direction and the position of the positioning device (28) being changeable in the axial

direction or in the direction of a rotational or swivel axis assigned to this rotational or swiveling direction, wherein the drive device (12) has exactly one electric motor (12), with an output shaft (10) rotationally driven by the electric motor (12) and the positioning device (28) is driven via this output shaft (10) both to produce the positional change of the positioning device (28) in the rotational or swivel direction and to produce the positional change of the positioning device (28) in the axial direction or in the direction of the rotational or swivel axis, and the position of the positioning device (28) in the rotational or swiveling direction in at least one position of the positioning device (28) being changeable essentially as a function of a positional change in the axial direction, or in the direction of the rotational or swivel axis via the electric motor (12) or its output shaft (10), and the positioning device (28) can be moved via this output shaft (10) in an essentially purely translatory manner in different rotational or swivel positions in the axial direction, or in the direction of the rotational or swivel axis and/or the positioning of the positioning device (28) in the axial direction, or in the direction of the rotational or swivel axis, being changeable in at least one position of the positioning device (28) essentially independently of a positional change in the rotational or swivel direction and it being possible to move the positioning device (28) in an essentially purely

rotational or swiveling manner in each of the different axial positions via the output shaft (10).

[c0013] 13. The actuating apparatus as described in Claim 11, for a motor vehicle transmission, said motor vehicle transmission having a plurality of gear steps with different ratios, it being possible to change a gear or the gear selected in the power or torque flow of the motor vehicle transmission using an actuating apparatus (1), this actuating apparatus (1) producing positioning movements during operation that enable this gear change and these positioning movements further being such that it is possible to shift from at least one selected gear step, alternatively, into at least three different other gears, that is, without it being necessary in the meantime to select or run through an additional gear, wherein the actuating apparatus (1) has exactly one electric motor (12) that effects all positioning movements of the actuating apparatus (1).

[c0014] 14. The actuating apparatus as described in Claim 11, wherein the part (20) of the nut/threaded spindle (18) that faces or is situated closer to the drive shaft (10) in the power flow is the threaded spindle (20), and the other part (22) of the nut/threaded spindle assembly (18) is the nut (22).

[c0015] 15. The actuating apparatus as described in Claim 11, wherein the actuating apparatus (1) has exactly one electric motor (12) with an output shaft (10) that is driven in a rotational manner during operation, this output shaft (10) being the drive shaft (10), and the electric motor (12) alternatively being driven or switched in such a manner that this output shaft (10) is loaded and driven in a first rotational direction (14) or in a second rotational direction (16) opposite the first one.

[c0016] 16. The actuating apparatus as described in Claim 11, wherein the actuating apparatus (1) is a motor vehicle transmission actuating apparatus (1) or a component of a motor vehicle transmission actuating apparatus (1) by means of which gears of a motor vehicle transmission can be changed.

[c0017] 17. The actuating apparatus as described in Claim 11, wherein the torsional lock, in particular acting in one direction, or the one-way clutch (102), in particular acting in one direction, for a plurality of gears that can be engaged in a motor vehicle transmission, and in particular for each gear, each as a separate locking position so that the positioning device (28) is held in a predetermined rotational position in each case or upon reaching this rotational position is held in this rotational position if the drive shaft (10) is driven in the second rotational direc-

tion (16).

[c0018] 18. The actuating apparatus as described in Claim 17, wherein the positioning device (28) in these particular holding or lock positions of the torsional lock or the one-way clutch (102) is moved in the axial direction in a purely translatory manner, if drive shaft (10) is driven in the second rotational direction (16) or is driven further, and a positioning element (36) of the positioning device (28) is moved in an essentially translatory manner and engages in a shift element (42, 44, 82, 84), such as a swiveling lever (42, 44) or similar device, and by this engagement and in some case at least one intermediately connected element, such as a selector rail, effects a synchronization in the motor vehicle transmission and/or a shift into a gear of the motor vehicle transmission, the stop or swiveling position being held by the torsional lock or the one-way clutch (102) being assigned to this gear.

[c0019] 19. The actuating apparatus as described in Claim 11, wherein by rotation of the drive shaft in the first rotational direction (14) a gear of the motor vehicle transmission can be selected by a further rotation or swiveling of the drive shaft in this first rotational direction (14) after driving against the stop (34).

[c0020] 20. The actuating apparatus as described in Claim 19, wherein the selected gear can be shifted via a rotation of the drive shaft (10), subsequent to the selection, in the second rotational direction (16) of the drive shaft (10).

[c0021] 21. The actuating apparatus as described in Claim 11, wherein the stop (34) is fixedly mounted on the threaded spindle (20).

[c0022] 22. The actuating apparatus as described in Claim 11, wherein a plurality of shift elements (42, 44), such as swivel-mounted swiveling levers (42,44), are provided that can be operated by the positioning device (28).

[c0023] 23. The actuating apparatus as described in Claim 22, wherein the swiveling levers (42, 44) and a swiveling axis (48) of the swiveling levers (42, 44) are positioned in such a manner that, when there is a translatory movement of the positioning device (28) and when rotational mobility of the positioning device (28) is blocked via the torsional lock that acts in particular in one direction or via the one-way clutch (102) that acts in particular in one direction, a positioning element (36) is moved onto an engagement area (50, 52, 54) of a swiveling lever (42, 44) and loads it when the engagement area (50, 52, 54) is loaded, it being possible to load each of the swiveling levers (42, 44) - at each corresponding or adapted rotational posi-

tion of the positioning device (28) - by this or any positioning element (36) of the positioning device (28), in order to effect engagement of a particular assigned gear of the motor vehicle transmission via this loading.

[c0024] 24. The actuating apparatus as described in Claim 23, wherein at least one swiveling lever (42, 44) can be loaded or operated via the positioning device (28) in both swiveling directions.

[c0025] 25. The actuating apparatus as described in Claim 11, wherein the positioning device (28) has a plate (30), on which a positioning element (36) is disposed, which is designed in particular as a bolt.

[c0026] 26. The actuating apparatus as described in Claim 11, wherein at least one elastic element, such as a spring (156), is provided and this elastic element (156) is loaded if there is synchronization via the actuating apparatus (1) within the context of engaging a gear in a motor vehicle transmission.

[c0027] 27. The actuating apparatus as described in Claim 26, wherein the elastic element is a spring (156) and the positioning device (28) has a plate (30) and a positioning element (36), as well as a bolt or pin, this spring (156) being supported on one side against the positioning ele-

ment (36) and in the other side against the plate (30).

[c0028] 28. The actuating apparatus as described in Claim 11, wherein a neutral position is assigned to each swiveling lever (42, 44) and an additional positioning device (56) is provided that moves predetermined swiveling levers (42, 44) into this neutral position if the positioning device (28) is moved onto the swiveling lever (42, 44), and specifically before the positioning device (28) operatively engages in one of the swiveling levers (42, 44) for the engagement of the gear in a motor vehicle transmission and/or to trigger a synchronization in the motor vehicle transmission.

[c0029] 29. The actuating apparatus as described in Claim 28, wherein the additional device (56) is firmly connected to the positioning device (28).

[c0030] 30. The actuating apparatus as described in Claim 28, wherein the swiveling levers (42, 44) each have at least two projections (50, 52, 54) directed in the direction of the positioning device (28) or the additional positioning device (56), and a swiveling axes (48) of the swiveling lever (42, 44) are disposed in such a manner that one of these projections (50, 52, 54) is moved outside the neutral position of the particular swiveling lever (42, 44) in an excursion in the direction of positioning device (28) or

the additional positioning device (56) and the other in the direction which is directed away from this positioning device (28) or additional positioning device (56), and that the additional positioning device (56), when the pertinent swiveling lever (42, 44) is moved into the neutral position, first loads the projection (50, 52, 54) that is moved in an excursion in the direction of the positioning device (28) or the additional positioning device, the additional positioning device (56) being able to engage between the projections (50, 52, 54) of the same swiveling lever (42, 44) and engages during or shortly before reaching the neutral position of the relevant swiveling lever (42, 44).

[c0031] 31. The actuating apparatus as described in Claim 28, wherein the additional positioning device (56) has a collar (58) and/or has or is a plate (80).

[c0032] 32. The actuating apparatus as described in Claim 28, wherein the additional positioning device (56) has at least one recess that enables the swiveling lever (42, 44) to be actuated is swiveled into this recessed area or is not blocked in its swiveling movement by the additional positioning device (56).

[c0033] 33. The actuating apparatus as described in Claim 11, wherein at least one displacement detection device (38) is provided and in particular a displacement detection de-

vice (38) having an incremental displacement sensor.

[c0034] 34. The actuating apparatus as described in Claim 33, wherein at least one displacement detection device (38) is provided that detects the rotational position of the positioning device (28), the positioning device (28) blocked by the stop (34) in at least one position also being blocked in the opposite direction from movement, so that this position can be used to calibrate the displacement meter (38).

[c0035] 35. The actuating apparatus as described in Claim 11, wherein the positioning device (28) in its relative movement is supported against a housing (130) and in particular via shoulders that engage within each other, of which one is disposed on the positioning device (28) and one is disposed on the housing (130), and between which is positioned a bearing bush (132), such as a plain bearing bush (132).

[c0036] 36. The actuating apparatus as described in Claim 11, wherein, by turning the drive shaft or output shaft (10) in the first rotational direction (14), gears in the motor vehicle transmission can be selected, the positioning device (28) in the selection being moved in an essentially purely rotational manner, and by turning the drive shaft or output shaft (10) in the second rotational direction

, which is opposite the first (14), the gear that is selected at the time can be shifted or is shifted.

[c0037] 37. The actuating apparatus as described in Claim 11, wherein an electronic control device (60) is provided, and this electronic control device (60) drives the electric motor (12).

[c0038] 38. A motor vehicle transmission having an actuating apparatus (1) as described in Claim 1.

[c0039] 39. The motor vehicle transmission as described in Claim 38, wherein this motor vehicle transmission is automatically controlled.

[c0040] 40. A drive train in a motor vehicle having an internal combustion engine and an automated actuation manual shift transmission having a plurality of gears and at least one friction clutch operating between the internal combustion engine and a transmission, wherein both the friction clutch and the gears are shifted using an actuating apparatus.

[c0041] 41. The drive train as described in Claim 40, wherein the shift transmission is a dual clutch transmission having two friction clutches and two transmission rods, each with multiple gears, each actuating apparatus (1) operating one friction clutch and shifting the gears belonging

to its transmission rod.

[c0042] 42. A use of an actuation device (1) as described in Claim 1 for the control of gear change operations in a motor vehicle transmission, and in particular as a shift and actuation apparatus (1) of a motor vehicle transmission or a friction clutch.

[c0043] 43. A method for the automated control of gear change operations in a motor vehicle transmission via exactly one electric motor (12) that has an output shaft (10) having the following steps: driving of the output shaft (10) of the electric motor (12) in a first rotational direction (14), in order to select at least one shift element (42, 44) for a gear to be selected in the motor vehicle transmission; and driving of the output shaft (10) of the electric motor (12) in a second rotational direction (16) opposite the first (14) in order to operate the shift element (42, 44) selected in the first rotational direction (14) by driving the output shaft (10) and thereby shift the corresponding gear of the motor vehicle transmission or engage this gear.

[c0044] 44. The method as described in Claim 43, wherein by driving the drive shaft (10) in the first rotational direction (14), a positioning device (28) is driven into a position in which a gear to be engaged can be selected.

[c0045] 45. The method as described in Claim 43, wherein, by driving the electric motor (12) or the output shaft (10) in the second rotational direction (16), a positioning device (28), such as a plate (30), is driven and moved along a threaded spindle (20) in a second orientation of the axial direction and then loads a shift element (42, 44), such as a swiveling lever (42, 44), so that this shift element (42, 44) is moved in such a way that a predetermined gear in the motor vehicle transmission is engaged, and by driving the electric motor (12) for the output shaft (10) in the first rotational direction (14), which is opposite the second (16), the positioning device (28) is driven and moved along the threaded spindle (20) in a first orientation of the axial direction, which is opposite the first, until this positioning device (28) or a spindle nut (22) connected thereto reached a stop (34), which in some cases is disposed on the threaded spindle (20), and by a continued driving of the electric motor (12) or the output shaft (10) in the first rotational direction (14) after reaching the stop (34), the positioning device (28) is moved in an essentially purely rotational or swiveling movement and a gear or a new gear to be selected.

[c0046] 46. The method as described in Claim 45, wherein the electric motor (12) or the output shaft (10) is driven in the second rotational direction (16) after selection of the gear

or the new gear, so that the positioning device (28) is moved along the threaded spindle (20) in the second orientation of the axial direction and engagement or shifting of the selected gear in the motor vehicle transmission is effected.

[c0047] 47. The method as described in Claim 45, wherein, when the electric motor (12) or the output shaft (10) is driven in the second rotational direction (16), a torsional lock acting in particular in one direction or a one-way clutch (102) acting in particular in one direction, especially in an automatic way, is moved into a stop position, which at least limits the positioning device (28) in its turning capability during the movement in the first and/or second transitory direction, and in particular when shifting or engaging a selected gear.

[c0048] 48. The method as described in Claim 45, wherein the shift element, such as swiveling lever (42, 44), has a predetermined area that when loaded triggers shifting into a predetermined gear, and, by the selection or by driving the electric motor (12) or the output shaft (10) in the first rotational direction (14) the positioning device (28) is positioned in a rotational position that is such that, by subsequently driving the electric motor (12) or the output shaft (10) in the second rotational direction (14) the positioning device (28) is moved in such a manner that it en-

gages in such an area that is assigned to the selected gear and effects the shifting into this gear.

[c0049] 49. The method as described in Claim 43, wherein the position of a moved element in the select direction and/or in the shift direction is determined.

[c0050] 50. The method as described in Claim 49, wherein the position is determined via an incremental sensor (38), and at least one reference position is provided that is used for the calibration of the incremental displacement sensor (38).

[c0051] 51. A method for the automated control of a friction clutch and a transmission in a drive train of a motor vehicle via exactly one electric motor (12) having the following steps: driving of the output shaft (10) of the electric motor (12) in a first rotational direction (14) in order to select at least one shift element (42, 44) for the operation of the clutch and a gear to be engaged in the transmission; and driving of the output shaft (10) of the electric motor (12) in a second rotational direction (16), which is opposite the first (14), in order - by driving the output shaft (10) - to operate the shift elements (42, 44) selected in the first rotational direction (14) and, thus, the friction clutch and to shift the corresponding gear of the transmission or engage this gear.